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To: Dr. S. Drell

Causes of Quality Loss in the C/M System

It is possible to assess, at least in a qualitative sense, the principal causes for image quality variation in the system. That there are variations in quality is a well observed fact based on subjective impression as well as MTF, RES and edge trace measurements. Some of these yard sticks, particularly MTF, are undoubtedly affected by the uncontrollable factors of haze, subject contrast, and scale changes. But others, notably edge traces, do indicate a sizable change in sharpness of detail. Furthermore, there are obvious losses in contrast due to instrument induced fogging.

Corona

One of the more serious defects is that of corona discharge which has been observed to fog the film, reducing the contrast and information content. It is notable in 9062 that the affected area correlates with frame spacing, indicating that the discharge is related to the film motion in the intermittent portion of its travel through the instrument. That the problem has been observed several times indicates that it is under very poor control.

Light Leaks

Fogging has occasionally been so severe that complete frames were severely exposed. Some returns show a small but noticeable contrast change across the width of the frame as indicated by comparing the small overlap areas of two adjacent frames. One also wonders about the over-all scene contrast which seems slightly low, possibly indicating veiling glare. Incidentally, veiling glare will not be detected by the usual measure of base fog in the frame borders. nor by edge measurements.

Focus

Changes in focus may be one of the more serious causes for loss in image quality, as examples 9050 and 1001. Sharpness of detail appears to change gradually throughout the mission. This is most easily detected by comparing the same object in the fore and aft frames. The differences can be quite substantial, even when small changes in gross contrast are taken into account, and can hardly be blamed on any other cause. The loss in quality seems to occur over the entire frame and for many frames in a row. Therefore, the drift of focus is gradual as one might expect from temperature changes resulting in thermal gradients.

There is no assurance that this is typical of missions for which temperatures are within tolerance since temperature telemetry is not adequate for detailed analysis.

Soft Spots

Occasionally there are localized areas of very unsharp images that persists from frame to frame. This is, apparently, a bad focus error. Perhaps the film is being raised above the rail out of reach of the focus rollers. This may be caused by accumulated gelatin being scratched off the film as the film is advanced.

Scratches

Scratches persist along the edges of film approximately in line with the edges of the rails which support the film. Since the film is advanced by drawing it across the rails, it seems likely that gelatin is being scraped off the film at this place. Tests performed at Eastman Kodak indicate that a hard deposit of gelatin can accumulate and tenaciously adhere to a metal surface.

Smear

Smear is a very occasional and can usually be associated with badly out of tolerance vehicle attitude. Smear is not known to be a serious problem. Seldom does an unsharp image, described under focus, have any directionality which might indicate smear.

Color Aberrations

Information on the effects of color aberrations can be gotten from the flight in which two different filters, a yellow (No. 12) and an orange (No. 21) were used on the two cameras. When the fore and aft images of the same object are compared it is obvious that there is a definite loss in image quality with the No. 12 filter. One finds it hard to attribute this loss completely to changes in scene contrast and it must be concluded that the loss is to a great extent due to color aberrations of the lens. Unless smear is an important enough problem under conditions of low sun and long exposure, there is probably no justification for the No. 12 filter with its greater transmittance.

Chromatic aberrations also indicate that color film will be of doubtful usefulness in the present C/M system since the removal of the filter needed for three-color photography will cause even greater losses in image quality than the small change from the 21 to the 12 filter.

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